令和４年度　９月修了

京 都 大 学 大 学 院 理 学 研 究 科

Ｄ Ｃ ３ 回 生 研 究 発 表 会
要旨集

２０２２年７月１２日（火）

物 理 学 第 一 分 野

物理学第一分野ＤＣ３回生研究発表会

場所：理学研究科５号館　５階・第四講義室＋オンライン
発表：２０分（別に質問１０分程度）

２０２２年7月１２日（火）９：３０～　開始

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１．Dynamics of dense non-Brownian suspensions under impact
Pradipto（９：３０）・・・・・　1

Dynamics of dense non-Brownian suspensions under impact

Physics of Matter and Statistical Dynamics Group   Pradipto

Abstract We numerically and theoretically study dense non-Brownian suspensions under impact. First, we investigate the rebound motion of an impactor. Then, we propose a phenomenology to explain the viscoelastic response of the impact process. Finally, we quantify the viscosity and elasticity of the dynamically jammed region induced by the impact and discuss the hopping motion on top of dense suspensions.

Non-Brownian suspensions (solid particles suspended on Newtonian fluid) with high volume fractions are ubiquitous in nature and exhibit interesting behaviors. One of them is that people can run on top of cornstarch suspensions, but sink if they walk. Such impact-induced hardening is less studied since most studies of the dense suspensions are conducted under shear [1]. Thus, we extend the coupled lattice Boltzmann method and discrete element method (LBM-DEM) for dense suspensions [2] to include the free surface of the suspensions and investigate the rebound motion of a free-falling spherical impactor to reproduce the experimental results [3]. We find that the rebound depends on the impact speed, the volume fraction of the suspensions, and frictional contact between suspended particles [4]. We also visualize local quantities inside the suspensions after the impact, which are not accessible yet by experiments. Then, we analyze the topological structure of the contact network between suspended particles (Fig. 1) using persistent homology. Second, we propose a simple phenomenology to capture the viscoelastic response of the impact process. As a result, we succeeded to explain the power-law relationships among the impact velocity, the maximum force exerted on the impactor, and the time to reach the maximum force on high impact speed [5]. Third, we delineate the dynamically jammed region induced by the impact and quantify its viscosity and elasticity [6]. Finally, we discuss the impact of a foot-spring-body system to mimic the hopping motion on dense suspensions.

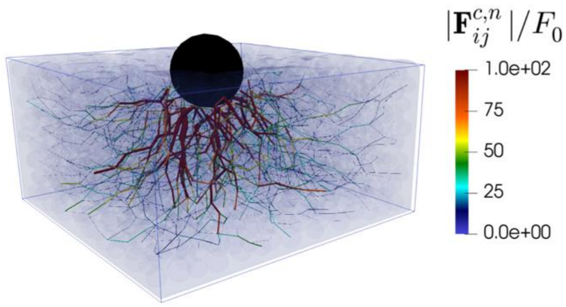

Fig. 1. Force chains induced by impact on dense suspensions.

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